



The relative difference of V_{40} , V_{60} and V_{65} between the planned value and the mean value of control plans were $\%V_{40} = -1\% \pm 16\%$, $\%V_{60} = -11\% \pm 13\%$, $\%V_{65} = -31\% \pm 33\%$.

Conclusions: The results indicate that there are variations in balloon position, with a tendency towards increased distance to the isocenter over time compared to the planning CT. This induces V_{65} and V_{60} to decrease whereas V_{40} is rather robust to the balloon shift. We could show that the dose to the rectal wall during treatment was the same or lower compared to the planned dose.

PO-0724

Comparison of volume delineation on simultaneous and standard cone beam CT images during arc radiotherapy (SCART).

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Purpose/Objective: Cone beam computed tomography (CBCT) verification images are typically obtained pre-radiotherapy for step and shoot intensity modulated radiotherapy (IMRT). Volumetric modulated arc therapy (VMAT) allows IMRT to be delivered using single or multiple treatment arcs and CBCT images can be acquired efficiently during treatment as the gantry rotates (simultaneous CBCT, sCBCT). These images are subject to image degradation from megavoltage scatter. The objective of this study is to assess feasibility of reliable organ delineation, and to compare organ position, on sCBCT as compared to CBCT in patients treated for prostate cancer.

Materials and Methods: Five patients had standard CBCT images and sCBCT images taken on fractions 2, 6, 11 and 16 of radical radiotherapy for prostate cancer. Each sCBCT image was corrected to account for MV scatter and improve image quality, yielding 3 datasets per fraction: pre-treatment CBCT, uncorrected sCBCT (usCBCT) and corrected sCBCT (csCBCT). Thus 12 images per patient were available for analysis. Prostate, rectum and bladder volumes were delineated using Pinnacle v9.0 by two observers. The conformity of comparative volumes between each pre-delivery CBCT and corresponding usCBCT and csCBCT was assessed using the Dice Similarity Coefficient (DSC: 1=unity, 0=no overlap of volumes). Mean centroid shift (geometric centre of mass) was calculated to assess gross volume movement.

Results: Results are shown in table 1.

Comparison metric	Bladder	Prostate	Rectum
usCBCT:CBCT Mean DSC (range)	0.74 (0.42-0.89)	0.70 (0.41-0.82)	0.72 (0.59-0.85)
csCBCT:CBCT Mean DSC (range)	0.77 (0.51-0.90)	0.70 (0.56-0.80)	0.74 (0.57-0.86)
usCBCT:CBCT Mean centroid shift (cm)	0.60	0.53	0.79
csCBCT:CBCT Mean centroid shift (cm)	0.53	0.52	0.59

Table 1: Mean bladder, prostate and rectum DSC values and centroid shifts (cm) for standard CBCT versus uncorrected sCBCT (usCBCT:CBCT), and standard CBCT versus corrected sCBCT (csCBCT:CBCT) comparisons.

Conclusions: Mean DSC values indicate a promising degree of conformity between standard CBCT and sCBCT, albeit with relatively large variation in centroid position. This may represent true variation in organ position between acquisition of CBCT and sCBCT, however the data set is small and inter- and intra-observer variability in outlining, in addition to contouring uncertainties due to poorer image quality of sCBCT may explain the disparity. Correction of sCBCT images does not appear to enhance conformity over uncorrected

images. Outlining target and organ at risk volumes on sCBCT is feasible, and thus sCBCT acquired have great potential for clinical practice. Using current techniques, the dose to the CTV and organs at risk is calculated using the radiotherapy planning CT. This represents a single point in time and dose predictions will not be completely accurate due to patient and organ motion during the course of treatment. sCBCT allows the position of structures to be identified during treatment delivery thereby removing this temporal disconnect and positional uncertainty. Ultimately intra-fraction imaging may allow the dose received by structures to be calculated more accurately and correlated with patient outcome and toxicity, in addition to increasing centre throughput and efficiency. This technique warrants further evaluation.

PO-0725

Variations in thermal parameters at hyperthermia for bladder cancer: A preliminary QA from an ongoing national trial

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Purpose/Objective: Hyperthermia (HT) is part of an ongoing bladder preservation national phase II trial using combined chemoradiotherapy following transurethral resection in $T_{2-4}N_0M_0$ bladder tumours in a national trial. According to the protocol intravesical temperatures between 41.5°C to 42.5°C had to be reached for 60 minutes at the weekly HT sessions delivered by the deep HT unit, BSD-2000. The aim of this study was to evaluate quality of heating, monitor specific thermal parameters during the HT sessions and explore the extent of their variability during multiple sessions.

Materials and Methods: Eight patients have been recruited in the protocol so far. A total of 43 HT sessions were delivered. Real time bladder temperatures were monitored using intravesical thermometry during 60 minutes of HT delivery. The thermal parameters evaluated were - minimum, maximum and average temperatures (T_{min} , T_{max} and T_{av}) respectively, temperature received by 20%, 50% and 90% of the target (T_{20} , T_{50} and T_{90}) respectively, cumulative equivalent minutes of T_{90} above 43°C (CEM43T90) and thermal dose (T_D).

Results: Of the 8 patients, 7 achieved a clinical complete response at completion of treatment. A total of 327 temperature data points were available for the analysis. Details of the measured values are summarized in the Table. Significant variability in the various thermal parameters was not observed, both within the individual patients and across the 8 patients. CEM43T90 was found to have quadratic relation with T_{min} , obtained by the expression, $CEM43T90 = 5805.61 - 291.7(T_{min}) + 3.66(T_{min})^2$ (model $r^2=0.90$, $p<0.001$) while T_D could be derived from the expression, $T_D = -165.2 + 13.3(T_{av}) + 1.3(CEM43T90) - 9.3(T_{90})$, (model $r^2=0.89$, $p<0.001$).

Parameters	Range (Min-Max in °C)	Mean \pm SD (°C)	p value (ANOVA)
T_{min}	36.5 - 42.2	40.3 \pm 1.2	0.598
T_{max}	40.2 - 43.1	41.8 \pm 0.8	0.943
T_{av}	39.6 - 42.7	41.2 \pm 0.9	0.648
T_{20}	39.8 - 43.0	41.6 \pm 0.9	0.550
T_{50}	39.4 - 42.7	41.3 \pm 0.9	0.621
T_{90}	39.2 - 42.5	40.7 \pm 0.9	0.636
CEM43T90	0.19 - 30.0	5.2 \pm 6.7	0.781
T_D	0 - 49	11.6 \pm 11.6	0.955

Conclusions: The various thermal parameters evaluated have not shown significant variability during multiple HT sessions. This could be a consequence of effective phase and amplitude steering feasible with the Sigma Eye HT applicator during these HT sessions. Mathematical models for computation of the key parameters, namely CEM43T90 and T_D were derived, which in future could be used to evaluate their roles as potential predictors of thermotherapy.